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Fossil insects from the Upper Permian of Natal, South Africa

by

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SYNOPSIS

Twelve new species are described from the *Daptocephalus* reptile zone of the Middle Beaufort Series, Natal. Two species (and genera) are referred to a new family, Ignotalidae, and superfamily in Homoptera; all other species are placed in described families. Ten new genera are erected, of which nine are monobasic: *Mioloptera* (*stuckenbergi*), *Liomoptoides* (*similis*), *Liomopterina* (*clara*), *Permonka* (*bifida*), *Ignotala* (*mirifica*), *Megoniella* (*multinerva*), *Austroprosboloides* (*vandijki*), *Dysmorphoscartella* (*lobata*) and *Redactineura* (*acuminata*). The tenth new genus (*Euxenoperla*) has two included species (*simplex* and *similis*). One new species (*similis*) is placed in *Agetochoristella* Riek, previously recorded from Australia.

The insect fauna consists mainly of Homoptera (five species) and Paraplecoptera (three species). There are two species of Plecoptera and one each of Miomoptera and Mecoptera. The fauna shows affinity to that of both the Angara Province of Asia and to the Australian Region.

INTRODUCTION

The only recorded Permian insects from southern Africa are *Rhodesiomylacris bond* (Zeuner 1955) (Blattodea: Mylacridae), from the Lower Beaufort Series, in Rhodesia, and *Boutakovia saleei* (Pruvost 1934) (Paraplecoptera: Homalophlebiidae), from the base of the Ecca, in the Democratic Republic of the Congo (formerly Belgian Congo).

Fossil insects are recorded in this paper from four localities in the *Daptocephalus* reptile zone of the Middle Beaufort Series of Upper Permian age. However, from only one locality, that near the Mooi River, has an adequate representation of the fauna been obtained. A single specimen is recorded from each of the other three localities. All localities are situated in the north-eastern sector of the Karoo basin.

The Upper Permian insect fauna from this zone shows affinity to that of both the Angara Province of Asia and to the Australian region, and there are also species unique to the African fauna. The large fore wing of *Ignotala mirifica* is unlike any previously known. The species is referred to the Homoptera but it has some of the attributes of the Protoblattodea, the order almost certainly ancestral to the Homoptera. *Megoniella multinerva*, although represented only by fragmentarily preserved wings, is apparently a related species. *Redactineura acuminata* is a cercopoid homopteron related to the Ipsviciidae from the Upper Triassic of Australia. This southern African species demonstrates that the two enigmatic species, *Uninervus zorapteroides* Becker-Migdisova from the Upper Permian of the Kuznetsk Basin, and *Mononeura angustipennis* Becker-Migdisova from the Upper Triassic of central Asia, should be transferred to the Homoptera from their less definitive placement in Paraneoptera *incertae sedis*.

There are also Homoptera in this Permian fauna comparable with those described from other faunas. *Austroprosboloides vandijki* is similar to *Austroprosbole maculata* Evans from

Australia, and *Dysmorphoscartella lobata* from the Upper Permian of southern Africa can be compared with species of the family Eoscartarellidae recorded from the Upper Triassic of Australia.

Paraplecoptera are represented in the Upper Permian of southern Africa by three species that are closely allied to Lower Permian species from the Kuznetsk Basin of southern Siberia. The miomopteron, *Permonka bifida*, is similar to *Permonikia permoniki* Kukalova from the Lower Permian of Moravia.

The mecopteron, *Agetochoristella similis*, and the stone-flies, *Euxenoperla* spp., from southern Africa are referred to genera that are otherwise recorded only from Australia.

The Upper Permian fauna of southern Africa, although a restricted one consisting mainly of Homoptera and Paraplecoptera, suggests warmer and drier conditions in the area of fossilization than pertained in the Australian region, the fauna of which indicates cold, moist conditions in relative close proximity to snow-covered areas or glaciers. Homoptera were abundant in both faunas but whereas most of the species in Australia were very small, those present in this part of Africa were large to very large species. Also, Mecoptera, which are mostly cold-adapted species with respect at least to the Recent fauna, were common in Australia and rare in southern Africa, whereas the Paraplecoptera and Miomoptera, orthopteroid (s.lat.) orders that are generally warm-adapted, occurred in southern Africa but are unknown from the very extensive Australian Upper Permian fauna.

Cockroaches are not known from any of the Upper Permian localities of the Karoo Basin. They are unknown also from the Australian Upper Permian. This suggests that even though the climate of this north-eastern sector of the Karoo basin was warmer than that at Belmont in Australia during the Upper Permian it was still moderately cold. However, the primitive cockroach, *Rhodesiomylacris bondi*, is recorded from the Lower Beaufort Series of Rhodesia (Zeuner 1955). This suggests that warmer conditions prevailed in areas to the north than in this sector of the Karoo basin during the Upper Permian.

LIST OF FOSSIL INSECTS

Mioloptera stuckenbergi gen. et sp. nov.: Paraplecoptera
Liomoptoides similis gen. et sp. nov.: Paraplecoptera
Liomopterina clara gen. et sp. nov.: Paraplecoptera
Permonka bifida gen. et sp. nov.: Miomoptera
Euxenoperla simplex gen. et sp. nov.: Plecoptera
E. similis sp. nov.: Plecoptera
Ignotala mirifica gen. et. sp. nov.: Homoptera
Megoniella multinerva gen. et sp. nov.: Homoptera
Austroprosboloides vandijki gen. et sp. nov.: Homoptera
Dysmorphoscartella lobata gen. et sp. nov.: Homoptera
gen. et sp. indet. ? Eoscartarellidae: Homoptera
Radactineura acuminata gen. et sp. nov.: Homoptera
Agetochoristella similis sp. nov.: Mecoptera

SYSTEMATICS

ORDER *PARAPLECOPTERA*

Family Liomopteridae

The family is recorded from the Permian of Russia and the Lower Permian of North America. The wings are of generalized form with a tendency for the cross-veins to be openly spaced and simple, although they are sometimes irregular between R and Rs. Sc extends at least past the middle of the wing.

Genus **Mioloptera** gen. nov.

Derivation. Mioloptera = corruption of *Liomoptera*.
Type species. Mioloptera stuckenbergi sp. nov.

Diagnosis. Similar to *Liomopterella* (Sharov 1961) from the Lower Permian of the Kuznetsk basin but the costal space wider and Rs arising closer to the wing base. Sc extending well beyond the middle of the wing, with numerous strong branches to the margin. Rs simple or 2-branched. M occupying a large area of the wing, with at least six terminal branches.

Mioloptera stuckenbergi sp. nov.

(Figs 1–3; Plate 1, figs 1–3).

Derivation. The species is named for Dr B. R. Stuckenberg, Natal Museum, Pietermaritzburg, for his kindness in allowing me to describe the fossil insects in the Natal Museum.

Type. NM 850 and paratypes NM 847 and NM 846 a, b, Natal Museum.

Type locality and horizon. Near Mooi River, Natal. *Daptocephalus* reptile zone, Middle Beaufort Series, Upper Permian.

Description. Length of holotype, as preserved, 23 mm, indicating a total length of *c.* 26 mm. Costal space wide, the fore margin of wing regularly convex. Sc with about 10 branches to margin, branches without obvious cross connections. R with several, short, terminal, forwardly-directed, pectinate branches. Rs arising close to wing base, simple or 2-branched, branching level with terminal branches of R. Inter-radial space rather narrow, cross-veins indistinct basally but apparently irregular, cross-veins simple distally, M arising close to base, first branching just before origin of Rs, MA with a few (4), close, subparallell branches all directed to wing apex. MP with branching similar to that of MA. CuA branching only towards wing margin. CuP and anals not preserved. Numerous short macrotrichia present at least on Sc, very dense towards wing base. Very dense fine hairs along fore margin of wing.

Genus **Liomoptoides** gen. nov.

Derivation. Liomoptoides = similar to Liomoptera.
Type species. Liomoptoides similis sp. nov.

Diagnosis. Hind wing, similar to *Kaltanella* and *Liomopterella* from the Lower Permian of the Kuznetsk basin of southern Siberia (Sharov 1961), but Rs only 3-branched.

Notes. Only the apical third of a hind wing is known. Although this is a hind wing, it is unlikely to be the hind wing of *Mioloptera*, based on fore wings, because of the branching of Rs.

Liomoptoides similis sp. nov.

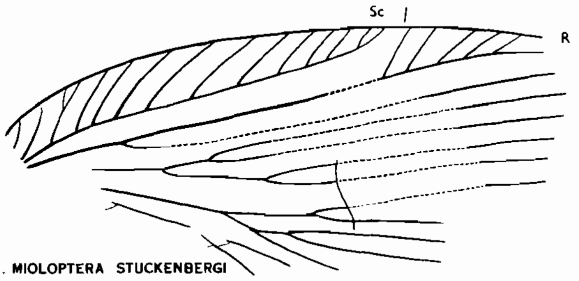
(Fig. 4)

Derivation. Similis in reference to similarity between this species and those of *Kaltanella* and *Liomopterella.*

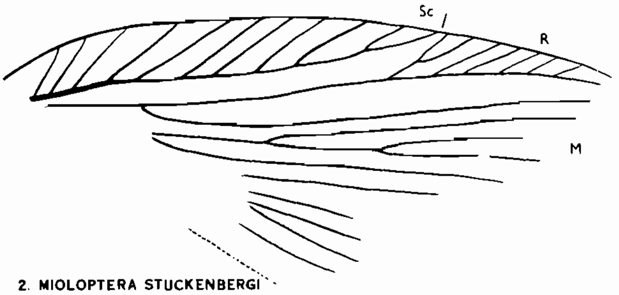
Type. NM 841 a, b, Natal Museum.

Type locality and horizon. Near Mooi River, Natal. *Daptocephalus* reptile zone, Middle Beaufort Series, Upper Permian.

Description. Length, as preserved, 9 mm, indicating a total length of *c.* 25 mm. Cross-veins simple over preserved portion of the wing, indistinct between R and Rs except for distal two



1. MIOLOPTERA STUCKENBERGI



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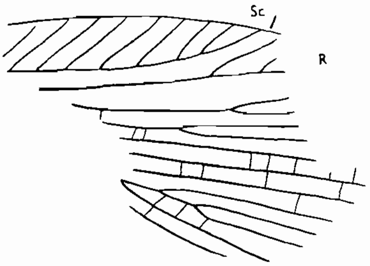

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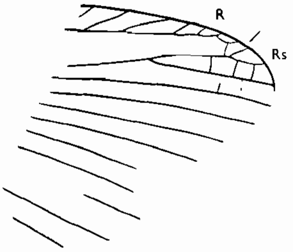
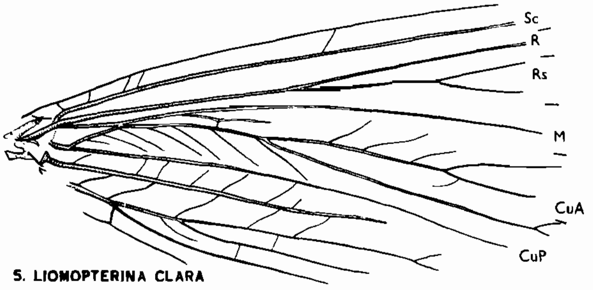


4. LIOMOPTOIDES SIMILIS

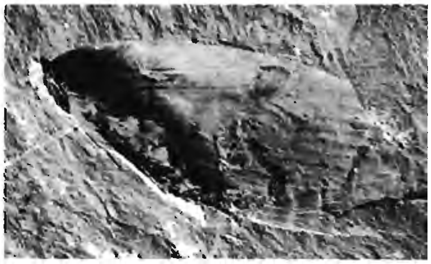


5. LIOMOPTERINA CLARA

Figs 1–3. *Mioloptera stuckenbergi* gen. et sp. nov. 1. Holotype. 2. Paratype NM 847. 3. Paratype NM 846.

Fig. 4. *Liomoptoides similis* gen. et. sp. nov. Holotype.

Fig. 5. *Liomopterina clara* gen. et sp. nov. Holotype.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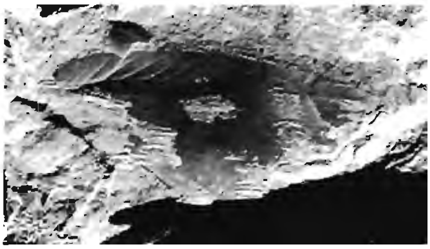
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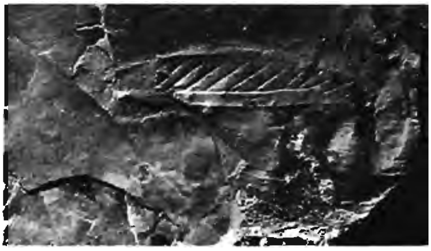
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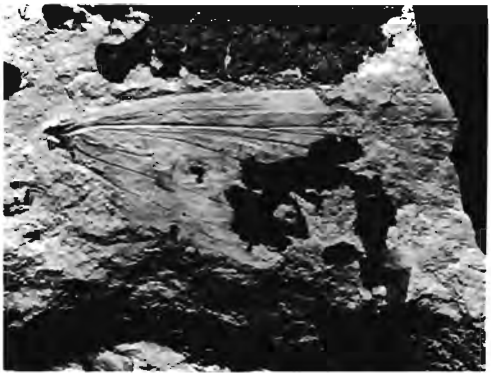
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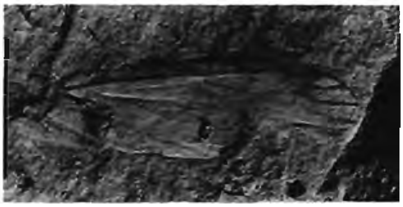
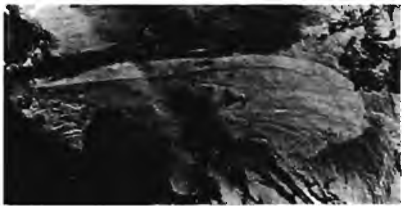

5. EUXENOPERLA SIMPLEX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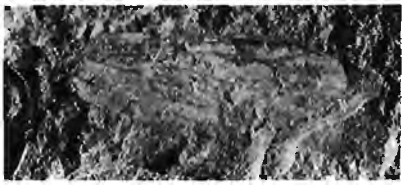

7. EUXENOPERLA SIMILIS

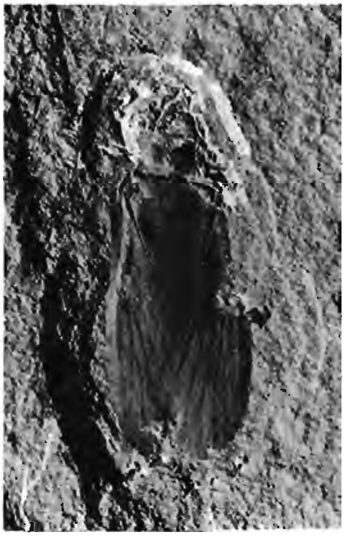

8. PERMONKA BIFIDA

PLATE 1

Figs. 1–3. *Mioloptera stuckenbergi* gen. et. sp. nov. 1. Holotype (NM 850). Print reversed. 2. Paratype NM 847. 3. Paratype NM 846a.

Fig. 4. *Liomopterina clara* gen. et sp. nov. Holotype (NM 854b).

Figs. 5–6. *Euxenoperla simplex* gen. et sp. nov. 5. Holotype (NM 845a). 6. Paratype NM 851. Print reversed.

Fig. 7. *Euxenoperla similis* sp. nov. Holotype (N–EW 22). Print reversed.

Fig. 8. *Permonka bifida* gen. et sp. nov. Holotype (NM 843a).

(others seen in reversed lighting). Rs 3-branched and with a terminal twigging. Limits between M and CuA not definitely ascertainable, combined area with seven branches at margin. CuP strong, straight, anal fan not preserved.

Genus **Liomopterina** gen. nov.

Derivation. Liomopterina = similar to Liomoptera.
Type species. Liomopterina clara sp. nov.

Diagnosis. Hind wing, similar to *Liomopterella* and *Kaltanella* from the Lower Permian of the Kuznetsk basin of southern Siberia (Sharov 1961) but M occupying a relatively smaller field in the wing and CuA with a series of oblique branches, towards the base, that end freely in the wing membrane without reaching to CuP. M and CuA connected by a very short cross-vein. 1A simple, widely separated from both CuP and 2A. Sigmoidally curved cross-veins between 1A and 2A.

Notes. Only the basal two-thirds of a hind wing, preserving part of the anal fan, is known. The basal axillaries are clearly defined.

Liomopterina clara sp. nov.

(Fig. 5; Plate 1, fig. 4)

Derivation. clara, because the type shows very clearly the basal wing structure and axillaries, and the origins of the main veins.

Type. NM 854 a, b, Natal Museum.

Type locality and horizon. Near Mooi River, Natal. *Daptocephalus* reptile zone, Middle Beaufort Series, Upper Permian.

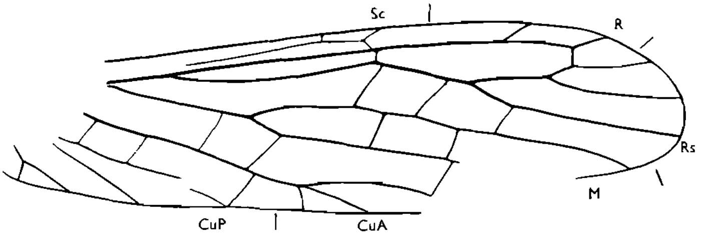
Description. Length, as preserved, 28 mm, indicating a total length of *c.* 40 mm. Cross-veins all apparently simple over the preserved portion of the wing, very oblique and sigmoidally curved between 1A and 2A. M forking before the origin of Rs. CuA deflected towards M close to its base, connected to M by a very short cross-vein. Basal 6–7 branches of CuA weak, oblique, ending in the wing membrane before reaching CuP. First strong forking of CuA before origin of Rs. Upper branch of M not partially fused with Rs, as in *Liomopterites*, but free, as in *Liomopterella* and *Kaltanella.* Lower branch of M weak. 1A and 2A partly preserved. 1A simple except possibly towards wing margin (apex of vein not preserved). 2A pectinately branched, branches very oblique (apices not preserved). Basal wing axillaries defined. Sc arising from base. R and M arising on a common stem. Cu with thickened basal stem. 1A thickened towards base and with depressed, thickened, transverse stem.

Notes. This could possibly be the basal portion of the hind wing of *Liomoptoides similis*, which is known only from the apex of the hind wing, although the two differ considerably in size, with *Liomopterina clara* almost twice the size of the holotype of that species. *Liomopterina clara* is not only much larger, also, than *Mioloptera stuckenbergi* but it differs in the branching of M.

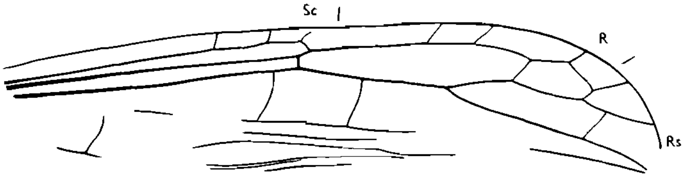
ORDER *MIOMOPTERA*

Family Permembiidae

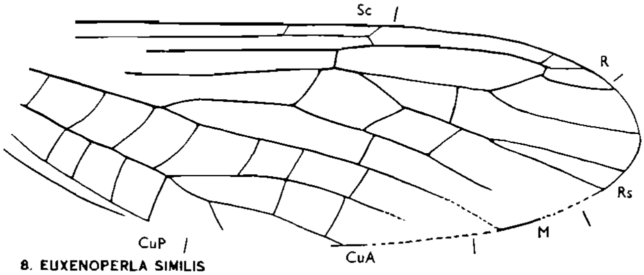
Kukalova (1963) referred this family to the Miomoptera whereas previous authors had either referred it to the Psocoptera (Tillyard 1928, 1937; Asahina 1971) or only doubtfully



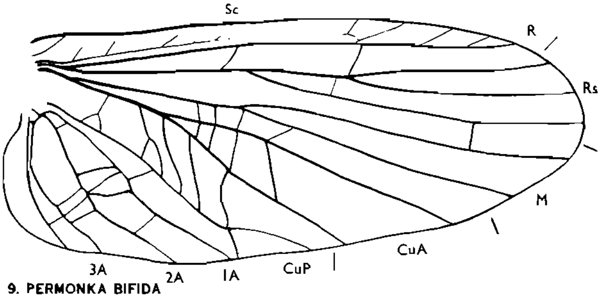
6. EUXENOPERLA SIMPLEX



7. EUXENOPERLA SIMPLEX



8. EUXENOPERLA SIMILIS



9. PERMONKA BIFIDA

Figs 6–7. *Euxenoperla simplex* gen. et sp. nov. 6. Holotype. 7. Paratype NM 851.

Fig. 8. *Euxenoperla similis* sp. nov. Holotype.

Fig. 9. *Permonka bifida* gen. et sp. nov. Hind wing of holotype.

referred it to the Miomoptera (Martynova 1962). I consider that the Permembiidae is the most generalized family of the Miomoptera, retaining many of the attributes of the ancestral Paraplecoptera, including numerous cross-veins, forwardly-directed distal branchlets on R, and a number of cross-veins in the costal space.

Genus **Permonka** gen. nov.

Derivation. Permonka = a corruption of Permonikia.
Type species. Permonka bifida sp. nov.

Diagnosis. Hind wing. CuA bifid, forking before middle. Both Rs and M arising very close to wing base. Cross-veins in anal area very irregular. Anal field markedly expanded, 3A widely separated from 2A. A small, short precostal area present at wing base. Sc extending at least to middle of wing. M apparently arising from CuA very close to base.

Notes. Both Rs and M arise closer to the wing base than in any other known Miomoptera although this condition is approached by *Permonikia permoniki* (Kukalova 1963). No other species referred to the Miomoptera has a precostal area with distinct costal vein, although the first branch of Sc is very oblique in *Permonia arta* Kukalova. Of the known Miomoptera, the genus can be compared most closely with *Permonikia* which, also, has an expanded anal field with numerous irregular cross-veins. It differs, however, in the deeper forking of CuA and very basad origins of Rs and M, which are the most distinctive attributes of the genus.

Permonka bifida sp. nov.

(Fig. 9; Plate 1, fig. 8)

Derivation. bifida in reference to the deeply forked CuA.

Type. NM 843 a, b, Natal Museum.

Type locality and horizon. Near Mooi River, Natal. *Daptocephalus* reptile zone, Middle Beaufort Series, Upper Permian.

Description. Whole insect, but anterior portion, including fore wings, indistinct. Folded hind wings, only, distinguishable. Length of hind wing 10 mm. A small short precostal area with distinct C: this could be a very oblique, most basal branch of Sc but it is more probably a distinct C. Sc weak but extending beyond middle of wing. R rather close to fore margin and with faint terminal branches to fore margin. Rs 3-branched, arising very close to wing base. M arising very close to wing base, appearing to arise on CuA. CuA and M touching only at a point.

ORDER *PLECOPTERA*

Superfamily Eusthenioidea

Family ? Gripopterygidae

Two southern African species combine attributes of the three (southern hemisphere) families of the Eusthenioidea. The openly spaced cross-veins, wide spacing between CuA and CuP, and absence of cross-veins in the anal field are all attributes of the Gripopterygidae and Austroperlidae which differ in the fore wings mainly in the cross-veins between Sc and the costal margin: cross-veins are abundant in Austroperlidae and openly spaced or absent in Gripopterygidae. In this attribute of the costal space the species apparently resemble Gripopterygidae.

Rs is at least 3-branched in the fossil species whereas it is never more than 2-branched in Gripopterygidae and Austroperlidae. However, it is at least 3-branched in Eustheniidae. In most other respects, however, the species differ from Eustheniidae in which there are abundant cross-veins over all the wing, including the anal field, Rs arises more distally towards the middle of the wing, and there are numerous cross-veins in the costal space, except in *Stenoperla.*

The species are tentatively referred to the Gripopterygidae. They differ from Recent species mainly in the up-arching of Rs at the basad cross-vein to R on a level with the apex of Sc, resulting in a wide subapical cell between R and Rs.

In the up-arching of Rs and presence of cross-veins in the distal half of the wing, the species can also be compared with the Perlopsidae recorded from the Lower Permian of the Urals (Martynov, 1940) but in the form and basad branching of M there is greater similarity with the Gripopterygidae.

Genus **Euxenoperla** gen. nov.

Derivation. Euxenoperla = primitive, strange Perla.
Type species. Euxenoperla simplex sp. nov.

Diagnosis. Wings rounded at apex. Rs of fore wing arising well before middle of wing, 3 or 4-branched, up-arched at basad cross-vein to R level with apex of Sc. Subapical cell between R and Rs widened. M deeply forked, branching before middle of wing but after origin of Rs. CuA branching after branching of M, the branches directed to the caudal margin. Cross-veins few, openly spaced except between basad sections of M and CuA, and CuA and CuP. Cross-veins present between branches of M.

Notes. Two species from the Upper Permian of southern Africa are referred to the genus. *Stenoperlidium triassicum* (Riek 1956) from the Upper Triassic of Australia is transferred to the genus.

Euxenoperla simplex sp. nov.

(Figs 6, 7; Plate 1, figs 5, 6)

Derivation. Simplex in reference to reduced venation.

Type. NM 845 a, b, and paratype NM 851, Natal Museum.

Other specimens. NM 840 (Natal Museum) preserves only the apex of a wing very probably of this species from the structure of Rs. NM 848 (Natal Museum) is a very fragmentary specimen very probably referable to the species. N-MN1 (Bernard Price Institute) differs slightly but is probably also referable to the species.

Type locality and horizon. Near Mooi River, Natal. *Daptocephalus* reptile zone, Middle Beaufort Series, Upper Permian. Other mentioned specimens also from this locality.

Description. Fore wing (holotype) (fig. 6). Length, as preserved, 19,5 mm, indicating a total length of *c.* 21 mm. Hind wing (paratype) (fig. 7) of comparable size, length, as preserved, 19 mm. Rs 3-branched, the distal two branches short. Basad cross-vein between R and Rs short so that the subapical cell between R and Rs is obviously widened beyond this cross-vein. Upper branch of M not distinctly up-arched at the basad cross-vein to Rs. Sc with 2 or 3 cross-veins to costal margin. R with 2 or 3 terminal branches to C. Three cross-veins between Rs and M. Three cross-veins between the branches of M. CuA

2-branched. 2A branched close to wing margin. Hind wing (fig. 7) similar anteriorly. Anal fan crumpled.

Euxenoperla similis sp. nov.

(Fig. 8; Plate 1, fig. 7)

Derivation. similis, because of similarity between this species and *simplex.*

Type. N-EW22, Bernard Price Institute.

Type locality and horizon. Estcourt, Natal. Road quarry just before gate leading to Wagondrift Dam club. *Daptocephalus* reptile zone, Middle Beaufort Series, Upper Permian.

Description. Length, as preserved, 14 mm, indicating a total length of *c.* 20 mm. Similar to *simplex* but Rs 4-branched with a terminal twigging on most posterior branch, and the stem of this branch arising level with the apex of Sc. CuA forking almost in line with the forking of M. Rs only slightly up-arched at basad cross-vein to R. Upper branch of M obviously up-arched at the basad cross-vein to Rs.

Note. This species differs from *simplex* in the branching of both Rs and CuA.

ORDER *HEMIPTERA*

Suborder Homoptera

Superfamily **Ignotaloidea** nov.

Diagnosis. Precostal area defined. Sc well developed. Only one included family.

Family **Ignotalidae** fam. nov.

Diagnosis. Fore wing. Sc with numerous branches. Main veins with numerous terminal branches connected by regular cross-veins. CuA and M widely separated at base. Rs arising towards the base of the wing. *Hind wing.* Venation much simpler than in fore wing, and cross-veins reduced except towards apex. Cross-veins present between R and the costal margin at least in middle section of wing.

Notes. Beaconiella Evans is transferred from the Fulgoroidea (Evans 1964) to this family. Three included genera, *Ignotala* gen. nov. and *Megoniella* gen. nov. from the Upper Permian of southern Africa, and *Beaconiella* from the Upper Triassic of Australia.

Genus **Ignotala** gen. nov.

Derivation. Ignotala = strange wing.
Type species. Ignotala mirifica sp. nov.

Diagnosis. Fore wing. Branches of Sc very oblique. Precostal area extending about one-fifth of wing from base. CuA strongly up-arched at the point of branching. *Hind wing.* Simple cross-veins between R and the costal margin at least in middle section of wing. Rs simple except possibly close to wing margin. CuA with apical branched portion distinctly arched.

Ignotala mirifica sp. nov.

(Fig. 10; Plate 2, figs 1, 2, 5)

Derivation. mirifica = wonderful.

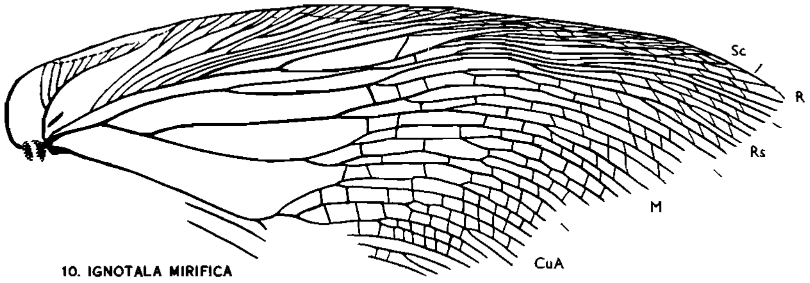
Type. Fore wing, N-MN3 a, b, Bernard Price Institute. Paratype, hind wing, NM 868, Natal Museum.

Type locality and horizon. Near Mooi River, Natal, *Daptocephalus* reptile zone, Middle Beaufort Series, Upper Permian.

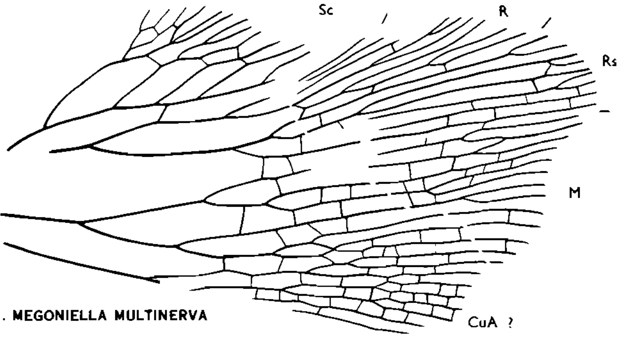
Description. Fore wing. Length, as preserved, 100 mm, indicating a total length of *c*. 105 mm. Hind margin not preserved. Precostal space distinct, wide at base. C with several branches to the wing margin. Sc with very oblique branches, numerous and secondarily branched, main stems closely spaced towards base but widely separated towards apex. R with several terminal branches. Main forking of M well before origin of Rs. Numerous cross-veins on disc of wing. All veins and cross-veins, especially in basal two-thirds of wing, with distinct setal pits. Wing membrane with dense finer setal pits. *Hind wing*. Length, as preserved, 35 mm, indicating a total length of *c*. 60 mm. Only middle section of wing. Cross-veins simple, numerous towards apex of preserved portion, and in costal space. Costal margin openly emarginate over preserved middle section of wing, very probably similar to Scytinopteridae. R branched towards apex. Rs simple except possibly close to wing margin. M with two main trunks and several branches. CuA with several branches, occupying a relatively large area of the wing. Anal field not preserved.

Notes. Difficulty arises in placing this large species in any order as currently defined. It combines attributes of the Protoblattodea and the Hemiptera. There is a distinct, short costal vein and enlarged precostal space in the fore wing, as in the orthopteroid and primitive neuropteroid orders. The subcosta, which extends almost to the apex of the wing, has numerous, very oblique branches reminiscent of those in *Mastotermes* (Isoptera) and, to a less extent, some primitive Paraplecoptera and Orthoptera. M arises on R, and it occupies a large area of the wing: the origin and main branching of the vein is similar to that in many Homoptera, and there are numerous terminal branches, also, in some Homoptera, e.g. Pereboriidae and other Fulgoroidea. The branched apex of CuA is strongly up-arched as in many Homoptera, and a few Plecoptera and Paraplecoptera. The anal area of the wing is not adequately preserved but it was small and almost certainly developed into a clavus. Except for the development of C and Sc one would not hesitate to refer the species to the Homoptera and relate it to the palaeontinid complex within the Cicadoidea, more especially as the wing is of large size. The fore wing can also be compared with those of the Pereiboriidae (Fulgoroidea). There is a distinct similarity between this fore wing and that of *Beaconiella*, from the Middle Triassic of Australia, which it resembles more closely than the very inaccurate illustration of *Beaconiella* would indicate. *Beaconiella* has a distinct, long, many branched Sc, but the branches are only moderately oblique, and a very large number of branches to the other veins (more than 30) at the wing margin. The two differ, however, in the origin of M in relation to that of CuA. CuA and M are very widely separated at base in *Ignotala*, more so than in most other Homoptera, and there is no indication of a cross-connection between M and CuA unless it is at the very base of the wing, in which case it is from CuA to the stem of R.

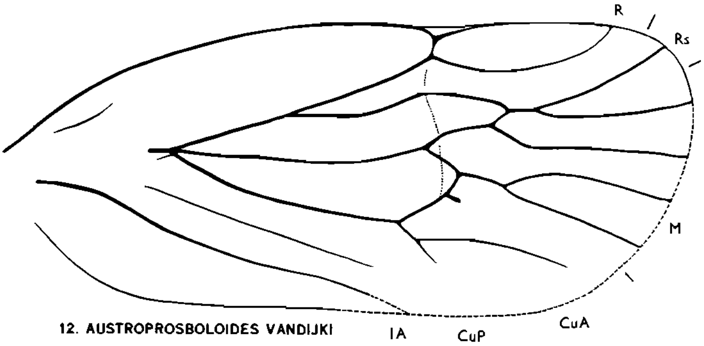
Although the species is intermediate in many attributes between the Protoblattodea and the Homoptera (Hemiptera), it is referred to the Homoptera on the apomorphic attributes of the basal origins of the main veins and the specialized cubitus, and the reduced hind wing venation. The species tends to support the view that the Homoptera are a derivative of the Protoblattodea.



10. IGNOTALA MIRIFICA

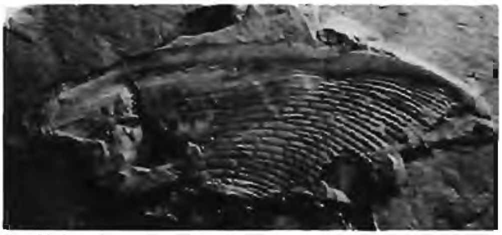


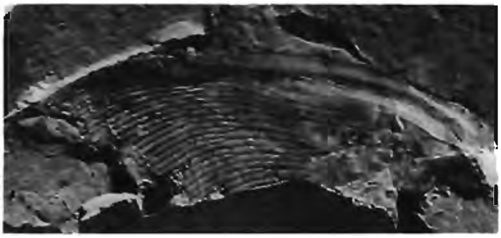
11. MEGONIELLA MULTINERVA



12. AUSTROPROSBOLOIDES VANDIJKI

Fig. 10. *Ignotala mirifica* gen. et sp. nov. Holotype.
Fig. 11. *Megoniella multinerva* gen. et sp. nov. Holotype.
Fig. 12. *Austroprosboloides vandijki* gen. et sp. nov. Holotype.


1. IGNOTALA MIRIFICA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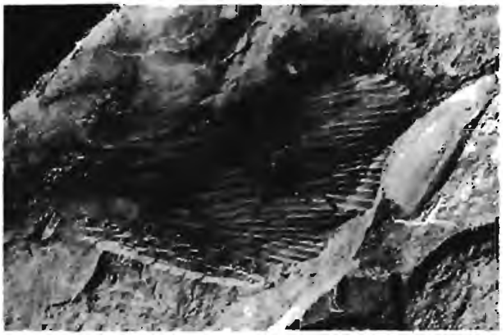
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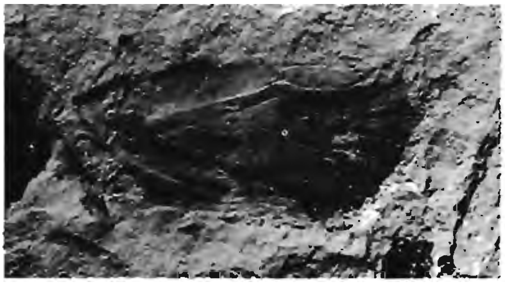
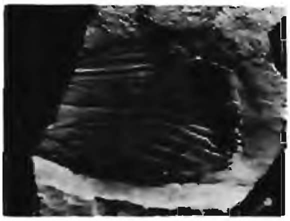

4. AUSTROPROSBOLOIDES VANDIJKI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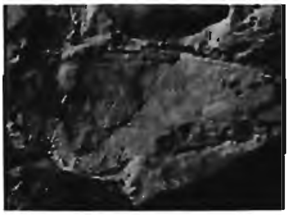
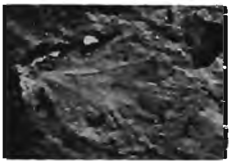
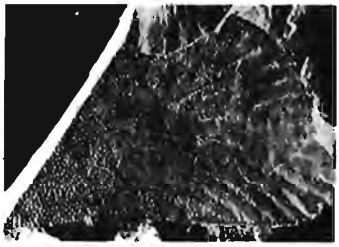

6. GEN. ET SP. IDENT.?


7. AGETOCHORISTELLA SIMILIS


8. DYSMORPHOSCARTELLA LOBATA

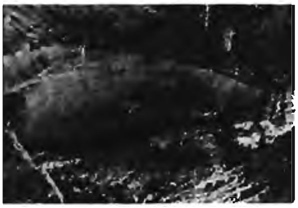

9. REDACTINEURA ACUMINATA

PLATE 2

Figs 1–2. *Ignotala mirifica* gen. et sp. nov. Holotype and counterpart (N–MN 3a, b).
Fig. 3. *Megoniella multinerva* gen. et sp. nov. Holotype (NM 849).
Fig. 4. *Austroprosboloides vandijki* gen. et sp. nov. Holotype (NM 844a).
Fig. 5. *Ignotala mirifica* Hind wing (NM 868).
Fig. 6. gen. et sp. indet. Homoptera: ? Eoscartarellidae (N–LK 505a).
Fig. 7. *Agetochoristella similis* sp. nov. Holotype (N–MN 2a).
Fig. 8. *Dysmorphoscartella lobata* gen. et sp. nov. Holotype (N–E Rd I 1a).
Fig. 9. *Redactineura acuminata* gen. et sp. nov. Holotype (NM 849).

Genus **Megoniella** gen. nov.

Derivation. Megoniella = corruption of moderately large.
Type species. Megoniella multinerva sp. nov.

Diagnosis. Costal space wide. Sc with a number of forward branches to wing margin, secondarily branched and with cross-connections between branches. R and Rs deeply branched, dichotomic. M forking in line with origin of Rs, dichotomously branched. CuA only partly preserved but deeply branched. Cross-veins simple and abundant. Secondary grooves between the branches of the veins towards wing margin.

Notes. The genus differs from *Beaconiella* from the Triassic of Australia in the wider costal space with more-branched Sc, and wider separation of the stems of Rs and M. It differs more markedly from *Ignotala* in the less oblique branching of Sc, more distal branching of M and absence of up-arching of the branches of CuA.

Megoniella multinerva sp. nov.

(Fig. 11; Plate 2, fig. 3)

Derivation. multinerva = many veined.

Type. NM 849, Natal Museum. Paratype MN 871 a, b, Natal Museum.

Type locality and horizon. Near Mooi River, Natal. *Daptocephalus* reptile zone, Middle Beaufort Series, Upper Permian.

Description. Length of holotype, as preserved, 28 mm, indicating a total length of *c.* 40 mm. R+Rs with 12 or more terminal branches. M with more than 10 terminal branches. CuA branching after the first branching of M, with at least seven terminal branches. Length of paratype, as preserved, an almost complete wing, 40 mm. Preservation less distinct than in holotype. Venation differing only in slight detail from that of holotype, with M forking very slightly closer to the base. Costal space broad over all preserved area.

Note. The holotype occurs on the same rock slab as the holotype of *Redactineura acuminata.*

Superfamily Cicadoidea

Family Cicadoprosbolidae

The family is represented in the Upper Permian of Australia by *Austroprosbole maculata* (Evans 1943) and in the Upper Triassic of Russia by *Cicadoprosbole sogutensis* (Becker-Migdisova 1947). The family is most probably ancestral to the Recent Tettigarctidae and the Mesozoic Dunstaniidae. A narrow ambient vein, at least over the apex of the wing, was probably present in all species.

The family differs from Prosbolidae in the origin of Rs from the middle of the wing, and not distally in line with the branching of M and CuA, and in having the apices of CuA directed more towards the apex of the wing than to the hind margin. It resembles the Dunstaniidae in the origin of Rs but differs noticeably in wing shape and in the absence of marked narrowing of the area between R and the wing margin beyond the node.

Austroprosboloides gen. nov. from southern Africa is closely related to *Austroprosbole* from Australia.

Genus **Austroprosboloides** gen. nov.

Derivation. Austroprosboloides = similar to *Austroprosbole.*
Type species. Austroprosboloides vandijki sp. nov.

Diagnosis. Similar to *Austroprosbole* from which it differs mainly in the more basad origin of Rs and the more arched basal half of Rs. The fusion of the upper branch of M with Rs for a short distance is probably only an abberation. Whole of wing membrane sculptured. Costal space very broad. A 'stridulation' ridge, ventrally, in the costal space towards base, and fore margin decidedly thickened towards base. Node on fore margin very clearly defined.

Austroprosboloides vandijki sp. nov.

(Fig. 12; Plate 2, fig. 4)

Derivation. This fine species is named for Dr D. E. van Dijk, Zoology Department, Natal University at Pietermaritzburg, and Honorary Keeper of Invertebrate Palaeontology, Natal Museum, who, together with his family, collected this and several other species from the Upper Permian near the Mooi River.

Type. NM 844 a, b, Natal Museum, and paratype N-MN 4, Bernard Price Institute.

Type locality and horizon. Near Mooi River, Natal. *Daptocephalus* reptile zone, Middle Beaufort Series, Upper Permian.

Description. Holotype. Fore wing complete. Length 13 mm. Whole of wing membrane finely tuberculate. A narrow sutural margin from node to at least apex of R. Cross-vein from M to CuA with a short spur vein (very probably only an individual variant). Clavus with two veins, the second close to the wing margin. CuA almost touching M close to the point of origin of M from R. Nodal line distinct, particularly over anterior half of wing.

The paratype wing is imperfect but it shows clearly the second vein in the clavus and also the 'stridulation' ridge in the costal space preserved as a mould of the lower surface of the wing (thus appearing as a deep groove). CuA is apparently more curved at its origin than in the holotype.

Superfamily Cercopoidea

Family Eoscartarellidae

Primitive Cercopoidea with thickened, sculptured fore wings, without basad fusion of stems of M and CuA, and rather basad origin of Rs.

The family is recorded from the Triassic of Australia (Evans 1956), and may include, also, *Tingiopsis reticulata* (Becker-Migdisova 1953) from the Upper Triassic of central Asia. A new genus from the Upper Permian of southern Africa is referred to the family.

Genus **Dysmorphoscartella** gen. nov.

Derivation. Dysmorphoscartella = Combination from *Dymorphoptilus* and *Eoscartarella.*
Type species. Dysmorphoscartella lobata sp. nov.

Diagnosis. Only apical half of fore wing known. Similar to *Eoscartoides* Evans, except in wing shape and with extra branching of the veins at the wing margin. R divided into two apical stems with a number of terminal branches. Rs simple. M with a number of terminal branches, in correlation with the distinct marginal lobe of the wing, which is limited to the apex of this vein.

Notes. The genus can be compared with the Dysmorphoptilidae, and with *Trifidella* (Cercopidae) from the Triassic of Australia (Evans 1956). Even though the origins of M and CuA are not preserved in the African species, the simple form of the main branches and the deep initial branching of both R and M, are more similar to the condition in the Eoscartarellidae than in the Dysmorphoptilidae and Cercopidae, in which M and CuA are fused at base.

Even though *Dysmorphoscartella* is the oldest recorded genus of the family, it is more specialized in wing shape than the Australian Triassic representative of the family, for the apex of the wing is lobed. It does, however, have a larger number of terminal branches to the veins and in this respect is more primitive than the other species.

Dysmorphoscartella lobata sp. nov.

(Fig. 13; Plate 2, fig. 8)

Derivation. lobata from the apical lobe to the wing.

Type. N-E Rd I 1 a, b, Bernard Price Institute.

Type locality and horizon. Estcourt, Rondedraai Farm, Natal. *Daptocephalus* reptile zone, Middle Beaufort Series, Upper Permian.

Description. Width of wing *c.* 12 mm. Posterior branch of R 4-branched, dichotomic. M with the usual three main branches, but with several terminal branches. Three cross-veins between R and Rs, and two between Rs and M. Setal insertions (or tubercles) margining each side of the veins and cross-veins, also on wing membrane in the basal half of the preserved portion of the wing and the whole of the intercubital space. Ambient vein, virtually at wing margin, from apex of clavus to costal margin, at least over preserved portion of costal margin.

Note. The only plant associated with this insect was a species of *Glossopteris* which, most probably, was the host plant of the leaf hopper.

Family ? Eoscartarellidae

gen. et sp. indet.

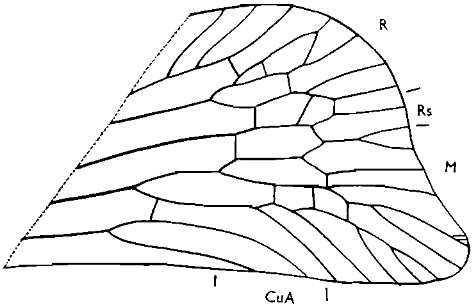
(Plate 2, fig. 6)

Specimen N-Lk 505 a, b, Bernard Price Institute, from Loskop, near Estcourt, Natal, is so fragmentary that even family placement remains in doubt. The wing membrane is distinctly, finely tuberculate, as in *Dysmorphoscartella lobata*, so the specimen is tentatively referred to the Eoscartarellidae. However, there is a distinct ambient vein at the wing margin, as in Dysmorphoptilidae.

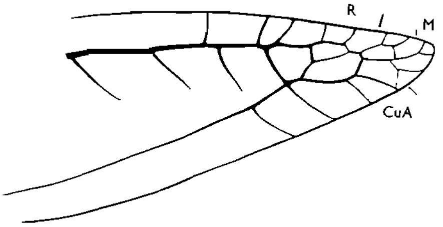
Family Uninervidae

The family is recorded from the Upper Permian of the Kuznetsk basin and the Upper Triassic of central Asia (Becker-Migdisova 1962) by two very similar genera based on long narrow wings with only one longitudinal vein in the wing.

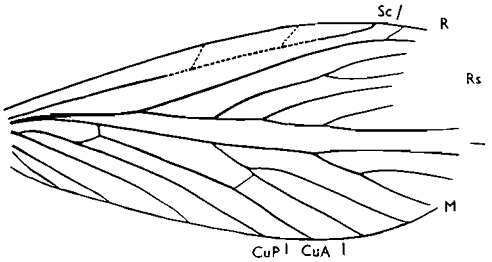
A new genus from the Upper Permian of southern Africa is referred to the family: it differs from the previously described genera in having a second longitudinal vein in the narrow wing, close to the posterior margin, and in the more complete venation apically.



13. DYSMORPHOSCARTELLA LOBATA



14. REDACTINEURA ACUMINATA



15. AGETOCHORISTELLA SIMILIS

Fig. 13. *Dysmorphoscartella lobata* gen. et sp. nov. Holotype.
Fig. 14. *Redactineura acuminata* gen. et sp. nov. Holotype.
Fig. 15. *Agetochoristella similis* sp. nov. Holotype.

On the basis of this genus, the Uninervidae are, apparently, most closely allied to the Ipsviciidae from the Triassic of Australia (Evans 1956) and Jurassic of central Asia. Although there has been disagreement on placement of the Ipsviciidae they are now considered to be abberant Cercopoidea. The Uninervidae would appear to be even more aberrant Cercopoidea.

Genus **Redactineura** gen. nov.

Derivation. Redactus and neura = reduced venation.
Type species. Redactineura acuminata sp. nov.

Diagnosis. Wing elytriform. Venation very reduced except at extreme apex, with a distinct vein parallel to costal margin and second parallel to caudal margin. R with short branches to margin, resembling those of *Ipsvicia*. Posterior main vein branching towards apex, apparently into M and CuA. A strong cross-connection between CuA and R, and a series of more basad cross-veins, strong at origin on R but indistinct or not extending to CuA+M.

Notes. The genus can be compared with *Uninervus* from the Upper Permian of the Kuznetsk Basin and *Mononeura* from the Upper Triassic of Issyk-Kul, central Asia, in which the venation is even more reduced. The wing is similar to the apical half of that of *Ipsvicia* except that it is narrowed and lengthened: the venation is closely comparable except for the posterior connections between CuA and the wing margin.

Redactineura acuminata sp. nov.

(Fig. 14; Plate 2, fig. 9)

Derivation. acuminata = pointed, from apex of wing.

Type. NM 849, Natal Museum.

Type locality and horizon. Near Mooi River, Natal. *Daptocephalus* reptile zone, Middle Beaufort Series, Upper Permian.

Description. Distal half of an elytriform fore wing. Length, as preserved, 12 mm. Apex of wing pointed. R 3-branched at apex and with more basal transverse connections to costal margin. Rs not distinguishable. M arising from CuA just distal to forking of R, apparently with four minute branches. CuA branched close to margin. Posterior main vein (= CuA+M) with a few transverse branches to posterior margin, the distal two branches strongest.

Note. The holotype occurs on the same rock slab as the holotype of *Megioniella multinerva*.

ORDER *MECOPTERA*

Suborder Eumecoptera

Family Agetopanorpidae

This family is dominant in the Permian of Russia, and occurs also in the Lower Permian of Kansas and the Upper Permian of Australia. The genera are based to some extent on the disposition of the branches of Sc but to a greater extent on the branching of Rs and M and the development of the cubito-median Y-vein. M is usually 6-branched but it is only 5-branched, with the extra branch on M_2 or M_4, in the Australian *Agetochoristella* (Riek 1953) and the Russian *Callietheira* (Martynova 1958).

A new species of *Agetochoristella* is recorded from southern Africa.

Genus *Agetochoristella* Riek

Agetochoristella Riek 1953.
Derivation. Agetochoristella — small *Agetochorista*.
Type species. *Agetochoristella adscita* Riek 1953: 68.

Diagnosis. Agetopanorpid with well developed cubito-median Y-vein, and M 5-branched, with the extra forking on M_2.

Agetochoristella similis sp. nov.

(Fig. 15; Plate 2, fig. 7)

Derivation. similis from similarity to Australian species of the genus.

Type. N-MN2 a, b, Bernard Price Institute.

Type locality and horizon. Near Mooi River, Natal. *Daptocephalus* reptile zone, Middle Beaufort Series, Upper Permian.

Description. Length, as preserved, *c.* 7 mm. Similar to *Agetochoristella adscita* but Rs_{3+4} forking well before Rs_{1+2} and with a deep fork on Rs_4.

Note. The species is very similar to the Australian species as far as can be ascertained from the somewhat imperfect preservation of the wing.

ACKNOWLEDGEMENTS

I am most grateful to Dr B. R. Stuckenberg for the opportunity to study the very interesting insect fossils in the Natal Museum collected by Dr D. E. van Dijk, Zoology Department, Natal University, Pietermaritzburg, and Honorary Keeper of Invertebrate Palaeontology, Natal Museum, and by members of his family. Study facilities were kindly provided by Dr J. A. Pringle, Director of the Natal Museum. It was a pleasure to visit and work with such a co-operative team.

I also express my appreciation of the ever-ready help and co-operation received from Heidi and John Anderson and Anna Benecke (now Malleson), in many details relative to this study of the Permian fossil insects collected by them and deposited in the Bernard Price Institute, University of Witwatersrand. I also wish to thank Dr Edna P. Plumstead for her interest and stimulation during my short visits to the Bernard Price Institute.

The line-drawings were prepared under my direction by Mrs Sybil Monteith. Most of the photographs were taken by John Green, at Canberra, Australia, and the remainder at the Bernard Price Institute.

I also record my appreciation of all persons who helped locate the fossiliferous horizons in this series of sediments. Their labours have resulted in increased knowledge of the species that lived during this early period in the ancestry of the insects.

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